4-2 Operations with Matrices
4-3 Multiplying Matrices

Norcom is a company that runs 3 factories to produce their 4 most popular products.

During the first week of the month, their output, measured in units, is as follows:

	Product 1	Product 2	Product 3	Product 4
Factory 1	6	3	2	0
Factory 2	0	4	8	5
Factory 3	4	2	1	0

Put the following data into a matrix.

$$A = \begin{bmatrix} 6 & 3 & 2 & 0 \\ 0 & 4 & 8 & 5 \\ 4 & 2 & 1 & 0 \end{bmatrix}$$

During the second week of the month, their production schedule changes and their output, measured in units, is as follows:

	Product 1	Product 2	Product 3	Product 4
Factory 1	3	3	0	1
Factory 2	0	6	5	2
Factory 3	10	2	0	1

Put the following data into a matrix.

$$B = \begin{bmatrix} 3 & 3 & 0 & 1 \\ 0 & 6 & 5 & 2 \\ 10 & 2 & 0 & 1 \end{bmatrix}$$

$$A = \begin{bmatrix} 6 & 3 & 2 & 0 \\ 0 & 4 & 8 & 5 \\ 4 & 2 & 1 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 3 & 3 & 0 & 1 \\ 0 & 6 & 5 & 2 \\ 10 & 2 & 0 & 1 \end{bmatrix}$$

What is the total production for each product at each factory after 2 weeks? (express in a matrix)

$$A + B$$

$$\begin{bmatrix} 9 & 6 & 2 & 1 \\ 0 & 10 & 13 & 7 \\ 14 & 4 & 1 & 1 \end{bmatrix}$$

Matrix addition and subtraction
- matrices must have the same dimensions
- each element is added/subtracted to the element in its corresponding location

$$A=\begin{bmatrix}6 & 3 & 2 & 0\\ 0 & 4 & 8 & 5\\ 4 & 2 & 1 & 0\end{bmatrix} \qquad B=\begin{bmatrix}3 & 3 & 0 & 1\\ 0 & 6 & 5 & 2\\ 10 & 2 & 0 & 1\end{bmatrix}$$

Suppose Norcom needs to meet a large order, how much production would they have if, during the second week, they are open twice as long? (express in a matrix)

$A+2B$ $2B=\begin{bmatrix}6 & 6 & 0 & 2\\ 0 & 12 & 10 & 4\\ 20 & 4 & 0 & 2\end{bmatrix}$

$=\begin{bmatrix}12 & 9 & 2 & 2\\ 0 & 16 & 18 & 9\\ 24 & 6 & 1 & 2\end{bmatrix}$

Scalar Multiplication
- multiplying every element by the same value

Matrix Multiplication
- If AxB, then # columns for A = # rows for B
- If A_{mxn} x B_{nxr} , then AB_{mxr}
- Every element in a row from A is multiplied by every element in a column from B and then added together

$A_{3x2} \times B_{2x6} = AB_{3x6}$

Example:

$C=\begin{bmatrix}5 & 4 & 8\\ -2 & 0 & 1\end{bmatrix}$ $D=\begin{bmatrix}-2 & 0\\ 6 & 4\\ 1 & -3\end{bmatrix}$

$C_{2\times3}$ $D_{3\times2}$

$C\cdot D_{2\times2}$

$\begin{bmatrix}5(-2)+4(6)+8(1) & 5(0)+4(4)+8(-3)\\ -2(-2)+0(6)+1\cdot1 & -2(0)+4(4)+1(-3)\end{bmatrix}$

$\begin{bmatrix}22 & -8\\ 5 & -3\end{bmatrix}$

ex:

$E=\begin{bmatrix}7\\ 3\end{bmatrix}$ $F=\begin{bmatrix}1 & 5\\ -3 & 2\\ 0 & 1\\ 4 & -2\end{bmatrix}$

2×1 4×2

$E\cdot F = \emptyset$

$F\cdot E = FE$ 4×2 2×1 4×1

$1,1 \quad 1(7)+5(3)$

$\begin{bmatrix}22\\ -15\\ 3\\ 22\end{bmatrix}$

Suppose the profit for each unit of products 1-4 is: 3, 10, 7, and 2 respectively.

What would be the total profit for each factory during the first week?

$A=\begin{bmatrix}6 & 3 & 2 & 0\\ 0 & 4 & 8 & 5\\ 4 & 2 & 1 & 0\end{bmatrix}$ 3×4 $P=\begin{bmatrix}3\\ 10\\ 7\\ 2\end{bmatrix}$ 4×1

$AP=$ 3×1

$\begin{bmatrix}62 & (1,1)\ 6(3)+3(10)+2(7)+0(2)\\ 106 & (2,1)\ 0(3)+4(10)+8(7)+5(2)\\ 39 & (3,1)\ 4(3)+2(10)+1(7)+0(2)\end{bmatrix}$

Suppose the volume for each unit of products 1-4 is: 8, 5, 1, and 4 respectively.

What would be the total storage space used for each factory during the first week?

$$A=\begin{bmatrix}6&3&2&0\\0&4&8&5\\4&2&1&0\end{bmatrix}_{3\times4} \quad V_{4\times1}=\begin{bmatrix}8\\5\\1\\4\end{bmatrix}$$

$$AV_{3\times1}=\begin{bmatrix}65\\48\\43\end{bmatrix}$$

If the the manager wanted to combine those calculations, she can as follows:

$$A=\begin{bmatrix}6&3&2&0\\0&4&8&5\\4&2&1&0\end{bmatrix}_{3\times4} \quad W=\begin{bmatrix}3&8\\10&5\\7&1\\2&4\end{bmatrix}_{4\times2}$$

$AW_{3\times2}$

Calculator

Homework:
p.164
14, 15, 25, 27
p172-173
13-20(hand), 31-34, 36- 39